The Impact of Age on the Value of Historic Homes in a Nationally Recognized Historic District

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Abstract

This article is the winner of the 2009 Real Estate Valuation category (sponsored by the Appraisal Institute) presented at the American Real Estate Society 25th Annual Meeting in Monterey, California.

This paper uses hedonic modeling to test the effects of age, both actual and effective, on the value of historic properties within a nationally recognized historic district. Findings show that there is a critical point where the value of historic properties is affected by actual age and the depreciation schedule turns upward. Effective age is used to develop a variant of Tobin's Q, which provides evidence that inter-district price differentials often attributed to historic designation are at least partially a function of investment differentials between districts.

Valuing properties in historic areas presents a series of challenges, which are complicated by the age of the structure. In a study of housing-related real estate risk, Rachlis and Yezer (1988) conclude that appraisal risk is most often associated with age. In many historic districts, the actual age of a majority of properties often exceeds one hundred years, and without significant renovation and/or rehabilitation activity, these buildings risk losing (or have lost) all economic value. Given that, standard hedonic models typically employ an age-related variable that fails to account for significant investment. While this is often a function of data availability, it contributes to heteroscedasticity in the error term, which tends to increase as dwellings age (Goodman and Thibodeau, 1995).

A unique feature of this paper is that it investigates the use of age as a predictor of value for historic residential properties in a nationally recognized historic district. Using property record data from Savannah, Georgia, our research shows that when estimating value it is important to model actual age and effective age separately, particularly in the context of historic preservation, and that effective age more accurately captures the value of depreciation than actual age. Two research questions are addressed. First, we hypothesize that there is a point where the value of historic properties as a function of the date of construction (the ''actual age'') is enhanced; that is, the properties are considered ''antiques'' and the depreciation schedule turns upward. If this is so, then one can assume that the oldest properties are in greater demand, resulting in higher values. This leads us to question the relationship between effective age and historic designation: Is value typically attributed to historic designation correctly assessed, or is it, as we suggest, more accurately a function of effective age, which represents investment in property rehabilitation and/or restoration? We explore the effective age specification, using it to develop a variant of Tobin's Q to measure the impact of the value to replacement cost ratio on price in two adjacent historic districts in Savannah. The resulting parameter estimate provides insight on the relationship between designation, investment, and value, as well as future renovation opportunities within the local market.

The paper is divided into four additional sections. The next section contains a theoretical discussion of the relationship between historic designation, property value, and actual and effective ages, which is followed by a discussion of the unique data set to be analyzed. A description of the historic Savannah property market, detailing its development, as well as providing an assessment of current conditions, is included. Next, the model estimates are discussed. The paper closes with concluding remarks.

Literature

Historic Designation and Value

Studies show that the creation of historic districts pays multiple dividends, both social and economic. The New York Landmarks Conservancy (New York Landmarks Conservancy, 1977) reported that historic district designation enhances a sense of neighborhood pride, serving to improve the social fabric of the community. Further, cities and neighborhoods actively seek historic designations to augment their property tax base, enhance tourism expenditures, and encourage private sector investment in business (Listokin and Lahr, 1997; TIAA, 1997; Winson-Geideman, Jourdan, and Gao, 2007).

Historic designation typically places a limit on property rights, restricting the owner's use of the property. Theoretically, this should result in a loss of value, though opportunities for income or property tax relief may offset the impact of that loss, particularly in the case of individual property designations. This has been challenged in a number of empirical studies, most recently by Narwold, Sandy, and Tu (2008), who studied the impact of the Mills Act, an initiative in California that allows municipalities to create historic designation programs. The basic premise of the program involves owners receiving a reduction in property taxes in return for agreeing not to alter the exterior of a historic property for a period of ten years. The authors found designated property sale prices to be 16% higher than similar, non-designated properties, and also found that amount to be greater than the capitalized tax benefit, implying value in the designation.

A study of historic commercial buildings in Winnipeg Manitoba by Cyrenne, Fenton, and Warbanski (2006) shows that certain classes of historic buildings (as defined by degree of historical importance) have higher assessed values than comparative, non-historic properties. The study also found that some classes, particularly those that are considered to be of the greatest historical importance, are more likely to be renovated than other classes. Even though renovation expenditures contributed significantly to higher property assessments, the impact of the increase was only 0.33 cents for each dollar spent.

While additional studies show that properties within historic districts typically sell at a premium (Ford, 1989; Asabere and Huffman, 1994; Clark and Herrin, 1997; Coulson and Leichenko, 2001), that premium can be dependent on the type of designation. A 1991 study by Schaeffer and Millerick found that nationally designated properties were positively impacted by the designation, but those with only local designations were negatively affected. The authors attribute the difference to the more stringent controls in the local area and the enhanced prestige associated with being part of a national district.

Historic designation is only one of several reasons that the demand for historic properties has increased. History cannot be replicated in new housing units, which limits the supply of such properties and contributes to escalating prices. Further, the old adage ‘‘they don’t make them like they used to’’ often holds true—building materials and techniques have changed over the years and the quality, character, and style inherent to historic properties is difficult and/or economically infeasible to duplicate. Given these facts, one might intuitively suspect that property age factors significantly in increased demand for historic homes and that the value of different vintages varies within designated historic districts.

Actual Age and Value

While a number of studies deal with age-related real estate issues, we are unaware of any that have a specific focus in the context of historic preservation, a unique feature of this research. There is, however, a significant body of research that addresses age as a proxy for depreciation even though it serves as an imperfect measure.[1] Age affects value in a non-linear manner for several reasons. First, as buildings depreciate, maintenance costs increase. The physical deterioration that occurs when necessary repairs are ignored (i.e., deferred maintenance) can result in a sale price lower than that of comparable properties within a given market. Conversely, investment in rehabilitation can result in depreciation rates that are lower than average (Knight and Sirmans, 1996) and thus capitalized into higher sale prices. A study by Chinloy (1980) showed the total depreciation rate of housing in Canada to be 1.52%, of which 37% was explained for by lack of maintenance. The "lemon" effect also introduces a level of risk into the depreciation measurement. If a building is regarded as being of poor quality or a "lemon," it will be sold at a discount (Dixon, Crosby and Law, 1999; Hulten and Wykoff, 1981).

Another reason age-related non-linearity is problematic in the hedonic function is attributable to functional obsolescence (Randolph, 1988; Wykoff, 1989; Yiu, 2002), which exists when a home has more or less of a feature than what is found in new housing. It is considered curable when it is profitable to make necessary alterations and incurable when the cost exceeds that which is available in a new home. Colwell (1991) discusses the relationship between functionally obsolete housing characteristics and hedonic theory, noting that functional obsolescence is often age-related, resulting from changes in technology, preferences, income or design. The author finds that when valuing functionally obsolete characteristics that are curable, the hedonic function deviates from the expenditure curve, which is contrary to Rosen's (1974) seminal research of the hedonic price function. The impact of technological change is captured in research by Colwell and Ramsland (2003). Using sales data for 43 large department stores in the United States, the authors found that, after controlling for both locational and physical depreciation, observable functional obsolescence nearly stops at a critical point in the property life cycle—in this case at the 16th year. Prior to that, the measured rate of technological change is 1.7% per annum regardless of reinvestment. Reinvestment after the critical point is shown to eliminate observable functional obsolescence.

Diaz, Hansz, Cypher, and Hayunga (2008) recognized the non-linear relationship between property age and value in a study of conservation districts, suggesting that older residential properties may have a higher value due to their unique characteristics and limited ability to reproduce the same structure. To correct for the linearity issue, each observation was placed in approximately equal age categories and assigned a binary designation of 1 if the age fell within a given category, 0 if it did not. Results show that homes ranging from 59 to 77 years of age sold at a premium when compared to those aged 48 to 50, and those aged 7 to 47 sold at a discount. Properties with an actual age greater than 77 years showed no significant difference from the control group.

Research on the effects of age on the value of office property shows significant, negative impacts as properties age. Frew and Jud (2003) found a negative impact in the Portland Oregon market, although the magnitude of the impact was small. Dermisi and McDonald (2010) found that age negatively impacts value in Chicago office buildings after controlling for renovation expenditures, and that a Class A designation markedly increased the value of properties built prior to 1972.

Effective Age

Given its limitations, what is the specification that is most useful when measuring age? Clearly the development of a variable accounting for renovation, rehabilitation, and/or maintenance expenditures is necessary to produce reliable estimates. Corgel and Smith (1981) present a theoretical and statistical model investigating the relationship between the economic life of a property and market value. The authors underscore the importance of variable specification, and recommend using remaining economic life as the most appropriate measure since it factors in rehabilitation expenditure.

Epley (1990) builds on the Corgel and Smith (1981) model with a theoretical and algebraic estimate for the calculation of effective age for single-family structures. He recommends estimating the economic life of both the subject and comparables beginning with the Society of Real Estate Appraisers (1984) method for deriving the economic life of a property. The effective age estimate is then calculated as a function of the actual age of a property, its remaining economic life, reproduction cost, and sale price adjusted for financing conditions. The subject is modified relative to the remaining economic life of the comparables. Thus effective age, when used in the context of property appraisal, is defined as a concept that ''represents an excess or deficiency in repair, remodeling, functional design, and location or economic obsolescence of the subject relative to the level of the same variables in comparable markets,'' (Epley, 1990).

In places that are designated as historic, decreases in effective age can be used to approximate the effects of investment in preservation. For instance, a property that has an actual age of 100 years and an effective age of one year implies alterations significant enough to equal the utility of new construction, which includes market-driven characteristics relevant to that time. The importance of effective age as a valuation tool in markets distinguished by a large number of historic properties cannot be overstated, particularly when a property is quite old. Even so, it is noticeably absent from much of the established historic designation literature (Asabere, Hachey, and Grubaugh, 1989; Leichenko, Coulson, and Listoken, 2001; Narwold, Sandy, and Tu, 2008).

It is important to emphasize that the use of effective age does not preclude the use of actual age, which also plays an important role in historic property valuation. The question, then, is if effective age acts as a measure of functional obsolescence, what is actual age measuring? In this research we hypothesize that actual age captures some unmeasured housing characteristic that is a function of the year the property was built, similar to the ''vintage effect.'' The vintage effect clarifies the relationship between current consumer preferences and the supply of housing of a given vintage or vintages (Goodman and Thibodeau, 1995). We recognize that there is likely a point where older homes are perceived as ''antiques'' and actual age enhances value. We further posit that effective age negatively impacts value, and use it to calculate the value to replacement cost ratio to estimate the impact of investment on inter-district price differentials in the historic Savannah market.

Data and Methods

Study Area

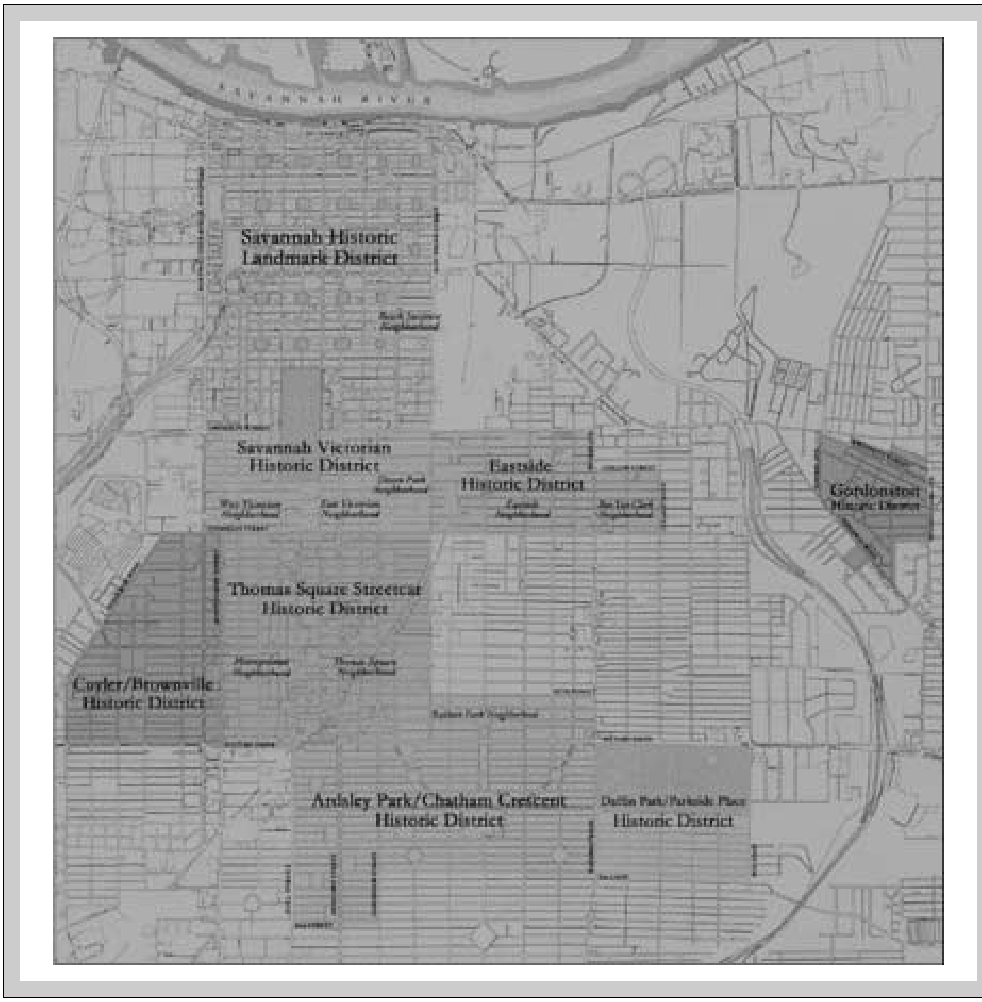
Preservation initiatives in Savannah are deeply rooted in a largely intact city plan first designed in 1733. The original plan created an orderly, functional town consisting of 24 squares placed at regular, short distances across the landscape. With 22 of the original squares still intact, Savannah is lauded as an example of outstanding engineering by scholars of contemporary urban planning. To its credit, the city has actively sought to preserve the squares and surrounding structures, receiving a great deal of support from the local community, non-profit organizations, and the private sector. In 1966, 1.1 square miles of the city were designated as a National Historic Landmark District (NHLD) by the National Park Service because of its unique, well-preserved city plan and historic building stock. The NHLD is home to about 1,100 buildings and is the primary geographic focus of this study. There are seven other historic districts in Savannah including the Victorian Historic District (VHD), which is considered the first ''suburb'' of the NHLD (Exhibit 1). It is adjacent to the NHLD, was originally developed from the 1880s to early 1900s, and serves as the second geographic focus area. While the same National Register designation is held by each district, local restrictions are more burdensome in the NHLD. For instance, exterior paint colors used in the NHLD must be approved by the local historic review board, while in the VHD there is no such requirement. Additionally, the NHLD is considered to be more pristine and desirable due primarily to the uninterrupted number of structures that have been preserved over time.

Since the 1990s the NHLD and the surrounding neighborhoods have seen considerable shifts in population demographics, which have likely been influenced by historic designation and are consistent with neighborhood gentrification. Economic indicators in the historic district including education, poverty, income, and employment show the 2000 population to be much more affluent and educated than residents were in 1990. These changes have been further exacerbated by a growing interest in Savannah as a tourist destination, with historic preservation often cited as the engine that drives the $1 billion industry (Winson-Geideman, 2007). Investment in real estate has increased rapidly, with the number of building permits issued almost doubling between 2002 and 2006 (Exhibit 2).

Data

Extensive data on sale, physical, time, and neighborhood characteristics are required to execute the multiple regression analysis necessary to compute the effects of age on value. These data were primarily acquired from the Chatham County Tax Assessor and include each property's address, as well as a series of structural characteristics and transaction information, such as sale price and year

Exhibit 1 | The Historic Districts of Savannah

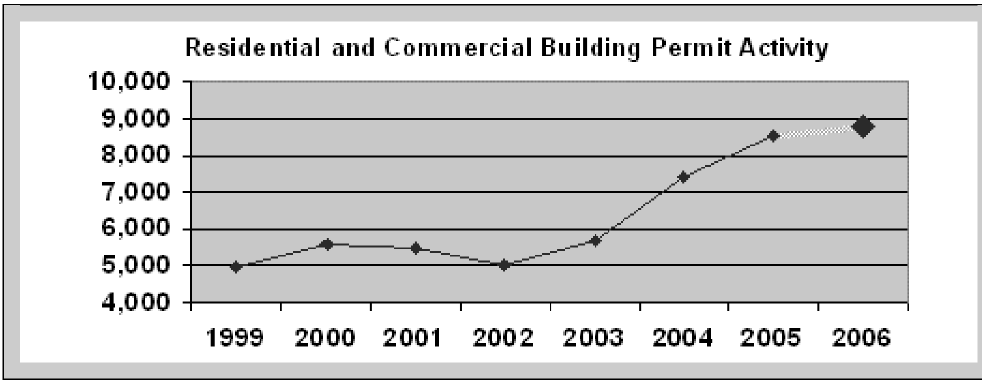


Source: The Historic Savannah Foundation.

of sale. Supporting data regarding property location were provided by the Savannah-Chatham Metropolitan Planning Commission, and the 2000 U.S. Census was used to acquire demographic data.

The data include a date described as the *effective year built* for a given structure. This designation is calculated by the local assessor and is essentially a determination of remaining economic life. A thorough review of building permits, the number, type and cost of renovations, exterior assessments, before and after photos, and in some cases, interior assessments are all factored into the estimate. As in Epley's (1990) model, the effects of functional and economic obsolescence

Exhibit 2 | Building Permits



Source: The City of Savannah Development Services.

are also considered (Bowen, 2008). Any impact is deducted from normal depreciation.

By calculating the difference between the year the property was sold and the effective year built, we are able to determine the effective age of the properties at the time of sale (*EFF_AGE*). The interpretation is intuitive: the more recently a property was renovated, the lower the effective age. Actual age was calculated in the same fashion, as the difference between the year the property was sold and date of construction (*ACTUAL_AGE*). In nearly all instances, the effective age (zero to 103 years) differs substantially from actual age (67 to 216 years).

The effective age specification is important not only because it is a more dependable measure of the effects of depreciation on value than actual age, but also because it can be used to evaluate the relationship between value and cost and subsequently assess development opportunities in the local market. Since the sale price, actual age, and effective age of the properties are known, it is possible to approximate the cost of constructing the property new, i.e., replacement cost (C), using the expression:

$$C = (SP * AGE)/(AGE - EFF), \tag{1}$$

where EFF is the effective age, SP is the sale price, and AGE is actual age.

It is not so much replacement cost that is of interest to this research, but rather the *ratio* of sale price to replacement cost. The variable Q, a variant of Tobin's q, is used in the hedonic model to specify the relationship between market value and replacement cost. Tobin's q implies that in the long-run, costs and value converge to equilibrium, and short-term disequilibrium drives profit-taking (Tobin, 1969). In property markets where $Q > 1$, incentives for the construction of new housing exist because market value exceeds replacement cost. As increasing demand for vacant lots, labor, and materials increase expenses, value and replacement cost start to converge. Thus at the point where $Q = 1$ there is no incentive to construct anything new, implying that the property market remains limited to existing housing.

Because the replacement cost estimate for this data are calculated as a function of effective age that includes an adjustment for economic depreciation, it is appropriately used to evaluate long-term investment opportunities in the historic Savannah real estate market (Corgel, 1997). It is important to emphasize that these data are limited to existing housing with a minimum effective age of zero, indicating that the property was renovated in the year of sale. When effective age is equal to zero, replacement cost is equal to value, thus the maximum observed value for Q is one. When effective age is greater than zero, replacement cost will exceed value because of the depreciation allowance. Since this study deals exclusively with existing housing, Q is equal to or less than one in all observations.

The Q value is used to estimate inter-district investment differentials and thus capture some of the price differences attributed to historic district designation. The district with the lowest Q value and highest effective age will have experienced the least amount of investment and therefore has the highest potential for profit-taking from renovation. Conversely, a high Q value and low effective age indicates substantial investment has already taken place, thus the potential for profits associated with renovation is lower relative to other areas.

Methods

The dependent variable used to evaluate the effects of age on property value is sale price (*SP*). Of note is the range in sale price for the data. Because of the historic nature of the properties that are being assessed, the data include observations with little economic value, as well as those that have benefited from substantial investment. The data only include those properties built prior to 1930, with the oldest dating to 1788. The observation with the lowest sale price, \$2,000, sold in 1995, with an effective age of 103 years. The most expensive property sold in 2001, with an effective age of 11 years and was built in 1882. Twenty-six properties have an effective age of 40 years or more. While the value range may appear extreme in comparison with other hedonic research, the purpose of this project, the historic nature of the study area and local market conditions, dictate inclusion of such data. Removing these properties would undermine the basic premise of the study.

The sales occur over a nine-year period, from 1995 to 2004. Vectors of structural, neighborhood, time, and location characteristics represent a series of independent variables, resulting in the following expression:

$$SP = \alpha + \beta_1 S + \beta_2 N + \beta_3 T + \beta_4 L + \varepsilon, \quad (2)$$

where SP is sale price, $\beta_1 S$, $\beta_2 N$, $\beta_3 T$, and $\beta_4 L$ are vectors of structural, neighborhood, time, and location characteristics, respectively. The error term, ε, addresses variables not accounted for in the model. The complete list of variables with operational definitions is shown in Exhibit 3.

Exhibit 4 shows the descriptive statistics used in the regression model, including number of observations, minimum and maximum values, as well as the mean and standard deviation for each of the variables. Casewise diagnostics were performed and outliers and observations with missing or obviously incorrect data were removed. The final data set includes 706 residential properties transacting between 1995 and 2004.

Exhibit 3 | Operational Definitions

Variable	Definition
Continuous	
SP[a]	Amount of last sale in dollars.
YEARS_SALE	2004 less most recent sale year.
BEDS	Number of bedrooms.
FULL_BATHS	Number of full bathrooms.
HALF_BATHS	Number of half bathrooms.
NO_DIPLOMA	Block group percent of residents over 25 years that did not graduate from high school.
ACTUAL_AGE	Year built less year of sale.
EFF_AGE	Effective year built less year of sale.
Q	Ratio of sale price to estimated replacement cost.
Binary	
CONDO	Condominium
DUP	Duplex
TOWN	Townhome
SF[b]	Single family
AVG-FAIR	Condition of structure is average or fair.
EX-VG-GOOD[b]	Condition of structure is excellent, very good or good.
NHLD	Property is located in the National Historic Landmark District.
VICTORIAN[b]	Property is located in the Victorian District.
ACTUAL_AGE 119+	Actual age of property at time of sale is 119 years or older.
ACTUAL_AGE 67–118[b]	Actual age of property at time of sale is 67–118 years.

Notes:
[a] The natural log of the sale price is used in the semi-log model.
[b] Reference category.

Exhibit 4 | Descriptive Statistics

Variable	N	Min.	Max.	Mean	Std. Dev.
Panel A: Continuous Variables					
SP[a]	706	2,000	650,000	169,362	123,189
W_i	706	55,871	590,423	320,232	103,233
YEARS_SALE	706	0	9	3.55	2.43
BEDS	706	0	9	2.63	1.25
FULL_BATHS	209	1	5	1.73	0.74
HALF_BATHS	706	0	3	0.31	0.50
NO_DIPLOMA	706	3.03%	41.46%	0.19	0.14
EFF_AGE	706	0	103	16.48	10.55
Q	706	0.00	1.00	0.84	0.12
	N	Min.	Max.	Percent of Total	
Panel B: Binary Variables					
CONDO	169	0	1	0.24	
DUP	138	0	1	0.20	
TOWN	67	0	1	0.10	
SF[b]	332	0	1	0.47	
AVG_FAIR	249	0	1	0.35	
EX-VG-GOOD[b]	457	0	1	0.65	
NHLD	512	0	1	0.73	
VICTORIAN[b]	194	0	1	0.27	
ACTUAL_AGE 119+	197	0	1	0.28	
ACTUAL_AGE 67–118[b]	509	0	1	0.72	

Notes:
[a] The natural log of the sale price is used in the semi-log model.
[b] Reference category.

Empirical Results

Specification Issues

A number of model iterations were prepared, including linear and semi-log models using sale price or the natural log of the sale price as the dependent variable. The independent variables generally performed as expected yet there were some inconsistencies. In particular the results in the semi-log model were weak relative to the other model, suggesting the need for a specification test such as the Box-Cox power transformation to determine the appropriate form.

Box and Cox (1964) developed a procedure for identifying the appropriate exponent, lamda (λ), that, unlike linear transformations, alters the shape of the data distribution, potentially converting a non-normal distribution into a normal distribution. Power transformations are often applied to "...[correct] skewness of the distributions of error terms, unequal error variances, and nonlinearity of the regression function," (Kutner, Nachtsheim, and Neter, 2004). Essentially, the procedure calls for the standardization of the dependent variables such that the magnitude of the error sum of squares is independent of the value of λ. Thus, a new dependent variable denoted as W_i is created, such that:

$$W_i = \begin{cases} K_1(Y_i^{\lambda} - 1), & \lambda \neq 0 \\ K_2(\ln Y_i), & \lambda = 0 \end{cases} \tag{3}$$

Where:

$$K_2 = \left(\prod_{i=1}^{n} Y_i\right)^{1/n}$$

$$K_1 = \frac{1}{\lambda K_2^{\lambda-1}}$$

The variable W_i is then regressed on the predictor variable(s) with varying values of λ. The value of λ that provides the lowest sum of squared errors is considered the appropriate power transformation. The transformed estimate for this data is .4 and the dependent variable revised, such that $W_i = (SP^{.4} - 1)/.4$.

Additional specification issues result from the limited availability of data. For instance, a measure of total size (i.e., square footage) would be appropriate in this market but was not provided by our data source. Other variable fields such as roof type, heating/cooling source, number of porches, and number of fireplaces were inconsistently populated and therefore unusable.

General Model Performance

The results of the linear, semi-log, and Box-Cox models are presented in Exhibit 5. The adjusted R^2 is very good at around .7 in all three models. It is important to note that while the coefficients are not directly comparable due to the different functional form, the signs, relative magnitude, and *t*-statistics are so.[2]

Exhibit 5 | Regression Equations using *ACTUAL_AGE* and *EFF_AGE* as Linear Measures

Variables	Linear	Semi-log	Box-Cox
Constant	137,881.16	11.96	322,537.10
	(6.22)***	(70.50)***	(17.93)***
YEARS_SALE	−15,622.41	−0.14	−15,088.04
	(−14.48)***	(−16.80)***	(−17.24)***
CONDO	−76,652.80	−0.56	−67,490.08
	(−8.74)***	(−8.41)***	(−9.49)***
DUP	−19,049.94	−0.08	−12,832.55
	(−2.61)***	(−1.44)	(−2.17)**
BEDS	−4,449.37	−0.07	−5,670.21
	(−1.30)	(−2.52)**	(−2.05)**
FULL_BATHS	69,806.39	0.35	48,945.43
	(14.71)***	(9.59)***	(12.72)***
HALF_BATHS	35,750.27	0.14	22,692.81
	(6.26)***	(3.23)***	(4.90)***
AVG_FAIR	−47,814.36	−0.51	−53,224.63
	(−6.97)***	(−9.78)***	(−9.56)***
NO_DIPLOMA	−2,525.79	−0.01	−1,841.23
	(−8.06)***	(−5.68)***	(−7.24)***
NHLD	55,832.52	0.54	58,577.19
	(6.10)***	(7.72)***	(7.89)***
EFF_AGE	−1,056.24	−0.01	−1,300.95
	(−4.20)***	(−7.52)***	(−6.37)***
ACTUAL_AGE	279.36	0.00	236.53
	(2.43)**	(2.20)**	(2.54)**

Notes: The dependent variables are: *SP* (adj. R^2 = .7024), *Ln_SP* (adj. R^2 = .6731), and ($SP^{.4}$ − 1)/.4 (adj. R^2 = .7210). *t*-ratios are shown in parentheses. VIF ranges from 1.075 to 2.992.
** Significant at the 95% level of confidence.
*** Significant at the 99% level of confidence.

In general, the variables perform as expected. The number of baths, both full and half, show a highly significant positive impact on value. Properties in fair to average condition (*AVG_FAIR*) sell for significantly less than those rated good, very good, or excellent (*EX_VG_GOOD*), and the number of years since the property sold (*YEARS_SALE*) contributes to a lower sale price. The *t*-ratios for all of the preceding variables are quite strong, falling between −17.24 and 14.71, and all are significantly different from zero at the 99% level of confidence.

Property type impacts value, with both condominiums (*CONDO*) and duplexes (*DUP*) priced lower than single-family homes (*SF*). The variable for townhomes

(*TOWN*) was not significantly different from that of single-family homes, thus it is not included in the reduced form model. The only surprising variation from normal expectations is the significant, negative effect the increasing number of bedrooms (*BEDS*) has on value in the Box-Cox and semi-log model. There are two possible explanations. Unrestored properties that were built to accommodate the large families of the past suffer from economic obsolescence due to their large size and lack of modern conveniences. Some of these homes have been restored, but not all. There is also evidence that some have been further divided and used as boarding houses for the low-income population. In this case, the data show there is a marginal decrease in value for each additional bedroom. These two explanations may also help explain the large positive effect each additional bathroom has on value.

The performance of the location (*NHLD*) and neighborhood (*NO_DIPLOMA*) variables is as anticipated. Properties located within the National Historic Landmark District sell at a premium, and those tracts with a high number of uneducated residents tend to have much lower property values.

Age Variables

Adjustments made for renovation expenditures and obsolescence allows effective age (*EFF_AGE*) to be treated as a linear measure, which serves as a much more appropriate proxy for depreciation than actual age. The strong, negative impact of *EFF_AGE* is as expected. In the linear model, each additional year of effective age results in a value reduction of just over $1,000 or a 0.75% decline.

In initial model iterations, actual age (*ACTUAL_AGE*) positively impacts value when used as a continuous descriptor. While the results are interesting, the underlying assumption is that age is valued consistently over all vintages of buildings, a finding inconsistent with theory. To capture that critical point where age becomes a significant predictor of value, a series of dummy categories representing ten-year incremental changes in the year a property was constructed were created (i.e., 1900 to 1909, 1910 to 1919, and so on) in a method similar to that used by Diaz, Hansz, Cypher, and Hayunga (2008). Regressions were produced to detect the category where age begins to positively affect value. Different specifications of the categories were tested and the critical point was eventually determined to be 119 years. Exhibit 6 shows the results when *ACTUAL_AGE119+* is substituted for *ACTUAL_AGE* in the regression equations. Note that the variable is positive and significant across functional forms.

But why, given the fact that the data include hundreds of historic properties, is 119 years that critical age? Theory suggests that part of the answer is economic and stylistic, that is the supply of such properties is much smaller than that of younger vintages, resulting in architectural styles that are more desirable. This implies that there may be additional breakpoints within the set of properties with an actual age greater than 119 years, possibly coinciding with a major historic

Exhibit 6 | Regression Equations using Actual Age 119+

Variables	Linear	Semi-log	Box-Cox
Constant	156,827.60	12.14	341,533.30
	(8.86)***	(88.805)***	(23.65)***
YEARS_SALE	−15,661.33	−0.14	−15,173.60
	(−14.70)***	(−17.00)***	(−17.46)***
CONDO	−76,345.21	−0.58	−68,671.03
	(−9.04)***	(−8.95)***	(−9.97)***
DUP	−18,608.26	−0.08	−12,507.40
	(−2.57)***	(−1.40)	(−2.12)**
BEDS	−3,960.72	−0.06	−5,363.64
	(−1.17)	(−2.44)**	(−1.94)*
FULL_BATHS	68,812.44	0.35	48,459.26
	(14.59)***	(9.52)***	(12.60)***
HALF_BATHS	35,308.54	0.14	22,391.47
	(6.23)***	(3.18)***	(4.85)***
AVG_FAIR	−47,394.70	−0.52	−53,196.53
	(−6.97)***	(−9.81)***	(−9.59)***
NO_DIPLOMA	−2,353.24	−0.01	−1,765.48
	(−7.48)***	(−5.53)***	(−6.88)***
NHLD	56,540.04	0.55	59,793.14
	(6.29)***	(7.99)***	(8.16)***
EFF_AGE	−1,035.55	−0.01	−1,297.49
	(−4.15)***	(−7.55)***	(−6.38)***
ACTUAL_AGE 119+	26,494.99	0.10	16,898.77
	(4.09)***	(2.09)**	(3.20)***

Notes: The dependent variables are: *SP* (adj. $R^2 = .7069$), *Ln_SP* (adj. $R^2 = .6730$), and $(SP^{.4} - 1)/.4$ (adj. $R^2 = .7226$). *t*-ratios are shown in parentheses. VIF ranges from 1.066 to 3.063.

*Significant at the 90% level of confidence.

**Significant at the 95% level of confidence.

***Significant at the 99% level of confidence.

event. Of the major events impacting Savannah, the Civil War is by many accounts the most important. All of the 197 properties with an actual age of at least 119 years were built between 1779 and 1883, with 110 (56%) constructed prior to the Civil War and 48 (24%) built during the post-war reconstruction period, which ended in 1877. Only three properties (1.5%) were constructed during the Civil War (1861–1865). The remaining 36 (18%) were constructed between 1878 and 1883. Results showed no significant difference between those properties built during and prior to the war relative to those built after. Additional models using

Exhibit 7 | Regression Equations using Q

Variables	Linear	Semi-log	Box-Cox
Constant	72,371.10	10.81	227,055.20
	(2.99)***	(57.90)***	(11.49)***
YEARS_SALE	−15,292.69	−0.14	−14,774.72
	(−14.43)***	(−16.61)***	(−17.09)***
CONDO	−73,738.14	−0.54	−64,903.53
	(−8.64)***	(−8.18)***	(−9.32)***
DUP	−18,570.92	−0.08	−12,562.43
	(−2.55)**	(−1.42)	(−2.12)**
BEDS	−4,346.15	−0.07	−5,797.81
	(−1.28)	(−2.61)***	(−2.09)**
FULL_BATHS	69,004.02	0.35	48,749.72
	(14.57)***	(9.59)***	(12.61)***
HALF_BATHS	35,879.21	0.15	23,015.90
	(6.31)***	(3.32)***	(4.96)***
AVG_FAIR	−47,346.01	−0.51	−52,697.06
	(−6.91)***	(−9.61)***	(−9.43)***
NO_DIPLOMA	−23,13.29	−0.01	−1,738.01
	(−7.33)***	(−5.44)***	(−6.75)***
NHLD	56,339.04	0.54	58,788.08
	(6.21)***	(7.71)***	(7.95)***
ACTUAL_AGE 119+	22,783.35	0.04	11,451.70
	(3.41)***	(0.77)	(2.10)**
Q	794.02	0.01	1,110.15
	(3.41)***	(7.27)***	(5.84)***

Notes: The dependent variables are: *SP* (adj. R^2 = .7046), *Ln_SP* (adj. R^2 = .6711), and ($SP^{.4}$ − 1)/.4 (adj. R^2 = .72). *t*-ratios are shown in parentheses. VIF ranges from 1.046 to 3.058.
** Significant at the 95% level of confidence.
*** Significant at the 99% level of confidence.

only those properties with an actual age of 119 years or greater found no additional breakpoints when various incremental changes in the date of construction were tested.

Q Ratio

The results for *Q*, which are shown in Exhibit 7, are quite interesting. Note the absence of the effective age variable due to collinearity issues. *Q* is not intended solely as a substitute for effective age, but rather it acts as an additional measure of remaining investment opportunity within the local market. While the value to replacement cost ratio ranges from 0 to 1.00 (Exhibit 4), the relatively high mean value (0.84) implies that renovation opportunities still exist but may be in limited supply, assuming that the value is trending upward. The linear model shows that for each percentage increase in Q, property value increases by 1.10%.

The relationship between Q and sale price requires some discussion. In markets where Q is less than one, Q will have a positive impact on price. The incremental effect decreases as Q approaches one, implying that Q and price are reaching the equilibrium point where renovation profit no longer exists and incentives are created for the construction of new housing. If Q exceeds one, value is greater than replacement cost, and thus Q has a negative impact on the price of existing housing in the hedonic model.

For an explanation of the relationship between Q and effective age, return to the equation estimating replacement cost [i.e., $C = (SP^*AGE)/(AGE - EFF)$]. Reworking the equation, we find that $EFF = (1 - SP/\mathrm{C})\ AGE$. The effective age for the overall market declines as costs and value converge. At the point where Q equals 1, the supply of properties in need of restoration has completely diminished, making EFF equal to 0. The obvious implication is that all properties have been restored and thus profit-taking from renovation is gone. At some future point where $EFF > 0$, depreciation has occurred and the market will have deviated from unity again, allowing profits to be made through property renovation.

Upon closer examination of *EFF_AGE* and Q, results show that the inter-district differential is at least partially driven by renovation expenditures rather than the degree of designation or any local zoning policy differences. In the NHLD, for example, the average effective age is 15.47 years, with a range of zero to 50 years; in the VHD, it is 19.16 years, with a range of zero to 103 years. The difference in effective ages infers that more investment has occurred in the NHLD relative to the VHD. Q shows similar differences, with a mean value of 85.15% in the NHLD and 79.40% in the VHD. The lower the value of Q, the greater the distance between value and replacement cost, implying that there are more renovation opportunities for existing properties available in the VHD.

This relationship is further illustrated by separating the data into two sub-sets, one containing properties in the NHLD and another for properties in the VHD. The impact Q on price in both the NHLD and VHD is shown in Exhibits 8 and 9, respectively. Separate regressions were produced using only the data for the specified district. The results of the linear model show that, in the NHLD, each percentage increase in Q results in a \$915 impact on value or an incremental increase of less than 1% (915.08/104,318.35 = 0.0088).

In the VHD, where replacement cost exceeds value by a larger degree, every incremental increase in Q results in an increase in value of \$950 that, when divided by the intercept, results in an impact of 1.47%. Thus, as value incrementally approaches replacement cost, the marginal sale price of existing properties

Exhibit 8 | Regression Equations using Q in the National Historic Landmark District Sub-sample

Variables	Linear	Semi-log	Box-Cox
Constant	104,318.35	11.39	281,629.45
	(2.81)***	(49.89)***	(10.21)***
YEARS_SALE	−15,592.03	−0.12	−14,017.96
	(−11.98)***	(−14.88)***	(−14.52)***
CONDO	−65,867.41	−0.49	−59,984.81
	(−6.57)***	(−7.89)***	(−8.06)***
DUP	−17,687.17	−0.14	−16,310.51
	(−1.56)	(−1.96)*	(−1.93)*
BEDS	868.97	−0.03	−2,068.67
	(0.19)	(−1.18)	(−0.61)
FULL_BATHS	70,337.40	0.33	47,864.14
	(12.58)***	(9.55)***	(11.54)***
HALF_BATHS	37,727.24	0.17	24,806.30
	(5.69)***	(4.29)***	(5.04)***
AVG_FAIR	−53,790.13	−0.51	−57,005.87
	(−5.75)***	(−8.94)***	(−8.21)***
NO_DIPLOMA	−2,270.16	−0.01	−1,577.88
	(−5.72)***	(−4.52)***	(−5.35)***
ACTUAL _AGE119+	19,736.21	0.05	10,991.27
	(2.59)***	(1.17)	(1.94)*
Q	915.08	0.01	1,013.22
	(2.26)**	(4.30)***	(3.37)***

Notes: The dependent variables are: *SP* (adj. $R^2 = .6733$), *Ln_SP* (adj. $R^2 = .6604$), and $(SP^{.4} - 1)/.4$ (adj. $R^2 = .6951$). *t*-ratios are shown in parentheses. VIF ranges from 1.051 to 2.423.
*Significant at the 90% level of confidence.
**Significant at the 95% level of confidence.
***Significant at the 99% level of confidence.

increases by 1.47%, holding all else constant. This indicates that not only does the district have greater profit-making potential through renovation, but also that less investment has occurred relative to the NHLD for the same time period.

Exhibit 10 summarizes the relationship between *Q* and value for the full sample and individual districts. Note that as *Q* increases, the marginal effect on sale price decreases. Conversely, the higher the effective age, the greater the impact of *Q* on price. While results support the notion that renovation opportunities exist across the sub-markets, the implication is that there is greater profit opportunity in the VHD. Further, the inter-district price differential appears to be at least partially driven by prior investment.

Exhibit 9 | Regression Equations using Q in the Victorian Historic District Sub-sample

Variables	Linear	Semi-log	Box-Cox
Constant	64,600.27	10.99	228,714.82
	(1.92)*	(25.91)***	(6.10)***
YEARS_SALE	−13,848.74	−0.18	−16,327.08
	(−8.08)***	(−8.15)***	(−8.56)***
DUP	−11,004.39	−0.04	−6,749.99
	(−1.33)	(−0.35)	(−0.73)
BEDS	−9,031.44	−0.12	−10,316.38
	(−1.90)*	(−1.96)*	(−1.95)*
FULL_BATHS	49,672.33	0.40	45,147.44
	(5.40)***	(3.41)***	(4.41)***
HALF_BATHS	21,117.36	0.06	15,118.03
	(1.91)*	(0.46)	(1.23)
AVG_FAIR	−39,636.45	−0.51	−47,232.31
	(−4.36)***	(−4.46)***	(−4.66)***
NO_DIPLOMA	−1,221.60	−0.02	−1,519.17
	(−2.01)*	(−2.19)**	(−2.25)**
ACTUAL_AGE 119+	15,722.81	0.33	29,281.38
	(0.57)	(0.95)	(0.95)
Q	949.03	0.01	1,279.47
	(3.86)***	(4.83)***	(4.68)***

Notes: There are no condominiums in the VHD data. The dependent variables are: *SP* (adj. R^2 = .4762), *Ln_SP* (adj. R^2 = .4522), and ($SP^{.4}$ − 1)/.4 (adj. R^2 = .4857). *t*-ratios are shown in parentheses. VIF ranges from 1.018 to 1.935.
*Significant at the 90% level of confidence.
**Significant at the 95% level of confidence.
***Significant at the 99% level of confidence.

Exhibit 10 | Relationship between Effective Age and Q

	Mean Effective Age	Min. Effective Age	Max. Effective Age	Mean Q (%)	Impact of Q on Price
Full Sample	16.48	0	103	84.00	1.10%
NHLD Sub-sample	15.47	0	50	85.15	0.88%
VHD Sub-sample	19.16	0	103	79.40	1.47%

Conclusion

While there is substantial empirical evidence that supports the premium in property value associated with historic properties, particularly when located in a nationally recognized district, we are unaware of any studies that specifically address age-related issues in the context of historic preservation. In this paper, we investigate the impact of age on price in a designated historic district, with the specific purpose of evaluating the critical point where age begins to positively impact property value. We also explore effective age, using it to assess the impact of investment on inter-district price differentials and to estimate investment opportunities within the local market. Two features that distinguish this data from that of other studies are the age of the properties, which ranges from 67 to 216 years, and the quality of the historic designation. The data are primarily sourced from the National Historic Landmark District in Savannah, Georgia, which houses about 1,100 properties listed on the National Register of Historic Places and is the largest such district in the United States. About 20% of the observations are residential properties located in the adjacent Victorian Historic District, the first ''suburb'' of the NHLD, which was developed in the 1880s.

The results empirically verify our original hypothesis: there is a point where age positively affects value and that point is 119 years in our sample. Buyers are willing to pay a premium for right to claim ownership of the oldest or one of the oldest homes in an area where age and history are revered, the ''antique effect.'' We were unable, however, to find any additional breakpoints within the sub-group of properties that were encumbered by the effect. Nor were we able to link any important historic events with the premium, with the exception of the 119-year breakpoint, which coincides roughly with the end of the post-Civil War reconstruction era.

While findings support the premise that designation plays a significant role in the valuation of historic properties, we show that the value associated with it is at least partially a function of investment differentials between the districts. This is illustrated by evaluating the sub-sample differences in effective age and Q, which show that properties in the sub-market where the greatest investment has taken place sell at a premium, and that the district with less prior investment has greater potential for future profits. Further research could investigate the use of Q as a depreciation correction mechanism in situations where price is less than replacement cost and actual construction costs are available.

Our research helps confirm the efficacy of the *effective year built* variable as estimated by the local assessor. This finding is important to the valuation community because of its applicability to assessment and valuation techniques, and we strongly recommend prioritizing the collection of such information. We show that by using it to calculate effective age and subsequently the value to replacement cost ratio (Q), future renovation opportunities within the historic property market can be estimated. In Savannah, the prospects for investment in the renovation of existing properties appear to be declining as value and cost converge. The relatively high mean value for Q (0.84) is further indication that this is so, which is not a surprising finding given that the rapid increase in the number of building permits issued by the city between 2002 and 2004 began to level off in 2005.

Endnotes

[1] Numerous studies on a variety of valuation topics use age as an independent variable that carries the expected negative sign. In the context of historic property valuation, however, age results are often mixed, as shown by Leichenko, Coulson, and Listokin (2001) in a study of historic properties in nine Texas cities. In three of the cities, actual age showed a significant positive effect on value, and in five of the cities the results were not significantly different from zero. The only negative and significant value was found in Dallas, which consequently was the only city with a depreciation control variable.

[2] By its very nature a historic district designation can serve as a de facto proxy for increased age since designated properties are typically older than non-designated properties. This may indicate potential collinearity issues between the district and age variables, particularly when compared to non-historic properties. Additional research comparing historic and non-historic properties is recommended.

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